California ISO
Shaping a Renewed Future

Solar and Wind Forecasting: Achieving a 33% Solution

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California ISO by the numbers

- Non-profit, for public benefit company
- 80% of California load served by the ISO
- 50,270 MW record peak demand (July 24, 2006)
- 30,000 market transactions per day
- 25,526 circuit-miles of transmission lines
- 286 million megawatt-hours of electricity delivered annually
- Governing Board appointed by the governor and confirmed by the state Senate

Challenges in operating the grid

Meeting energy and policy goals

Maintaining reliability with fewer gas units

Understanding ramping requirements

Stabilizing generation fleet characteristics

Forecasting

We need to balance reliability, renewables, sustaining the current fleet and reasonable cost

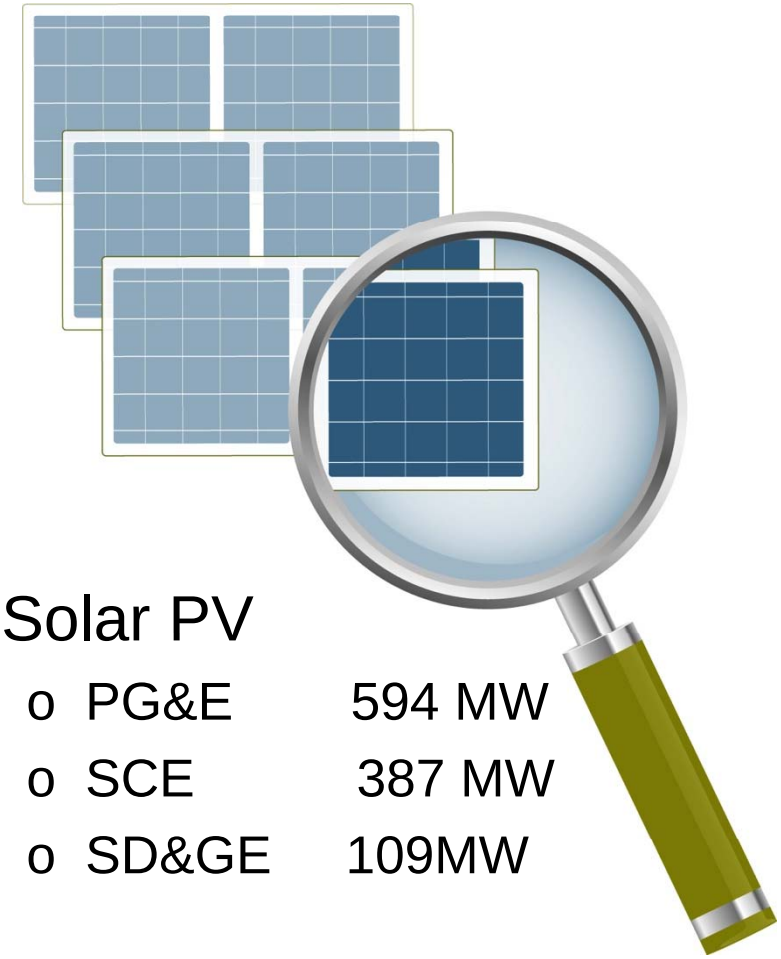
What are the Renewable Energy Resource under ISO control?

Technology	MW under ISO control
Wind	2,000
Geothermal	1,503
Small hydro (under 30 MWs)	1,156
Biomass	626
Solar thermal	0
Biogas	282
Solar PV	92

Technology	MW under ISO control
Digester gas	139
Municipal solid waste	
Biodiesel	
Conduit hydro	
Fuel cells w/renewable fuels	
Landfill gas	
Ocean wave & thermal tidal current	

What we don't see!

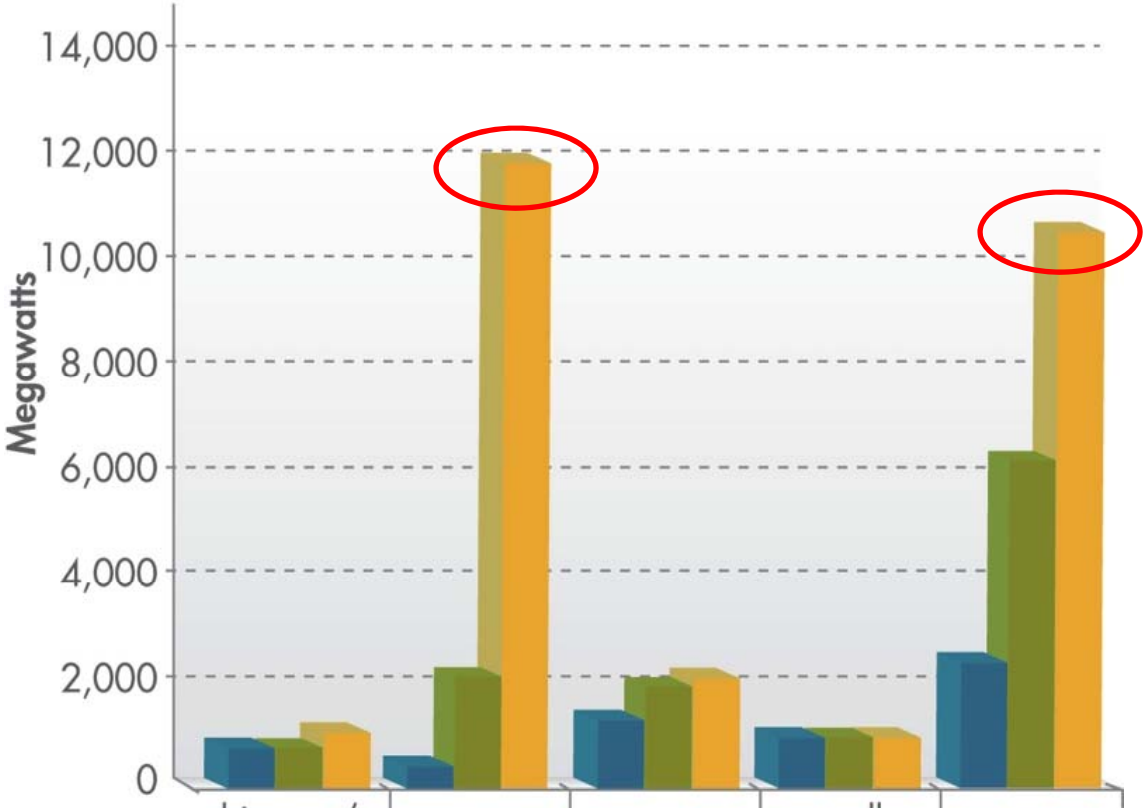
- Real time wind QFs
  - ~1700 MWs
- CA State Programs[1]
  - 2011 = 1026 MWs
  - 2016 goals = 3, 000 MW
  - CA Solar Initiative 1,940 MW
  - New Solar Homes Partnership 360 MW



- Solar PV
  - PG&E 594 MW
  - SCE 387 MW
  - SD&GE 109MW

[1] http://www.gosolarcalifornia.ca.gov/

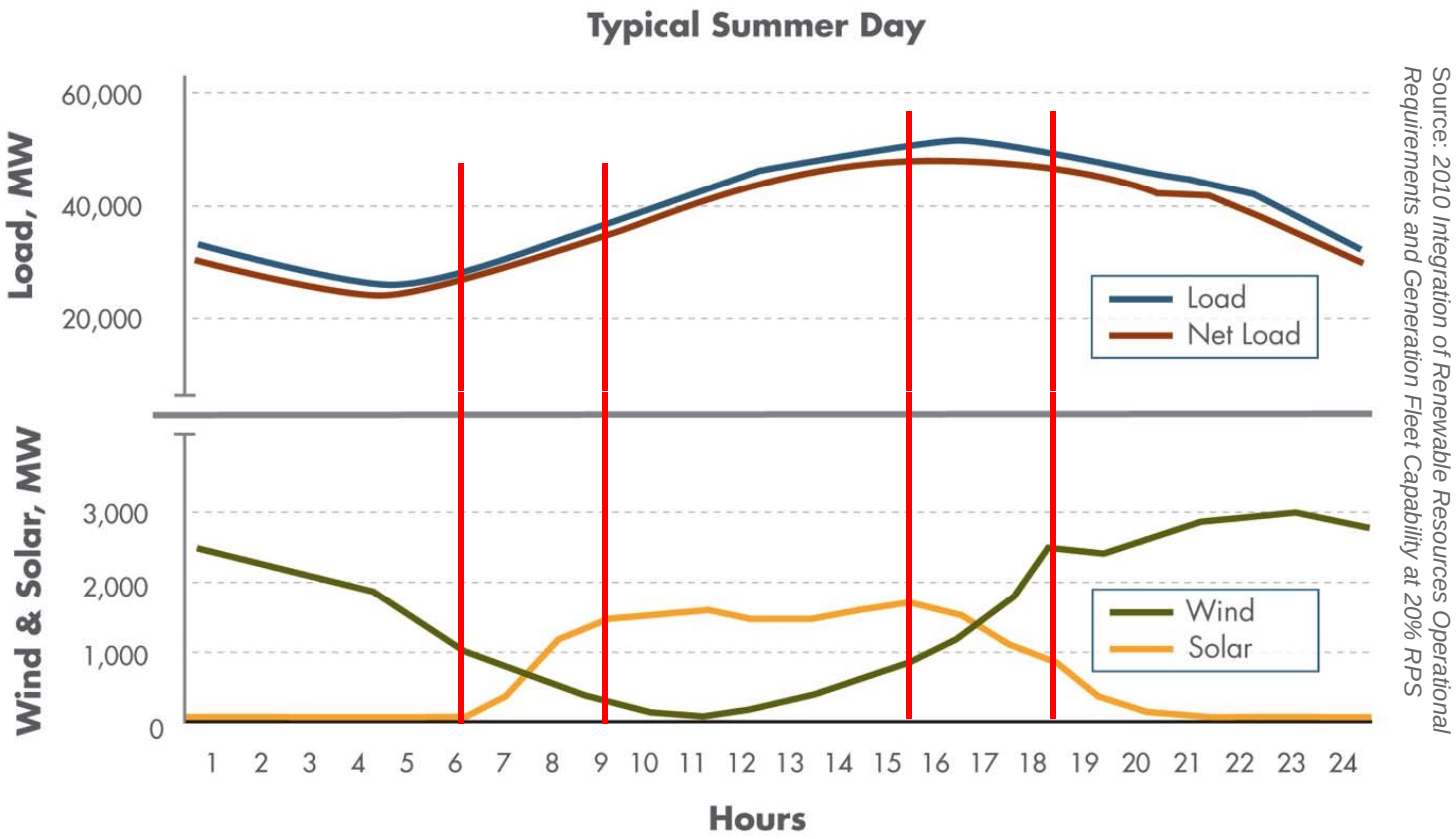
ISO studies show renewable future trend



	biomass/ biogas	solar	geothermal	small hydro	wind
2010	878	469	1,518	1,028	3,036
2012	878	2,246	2,341	1,028	6,688
2020	1,409	12,334	2,598	1,028	11,291

2011 Totals
Solar 601 MWs
Wind 3,748 MWs

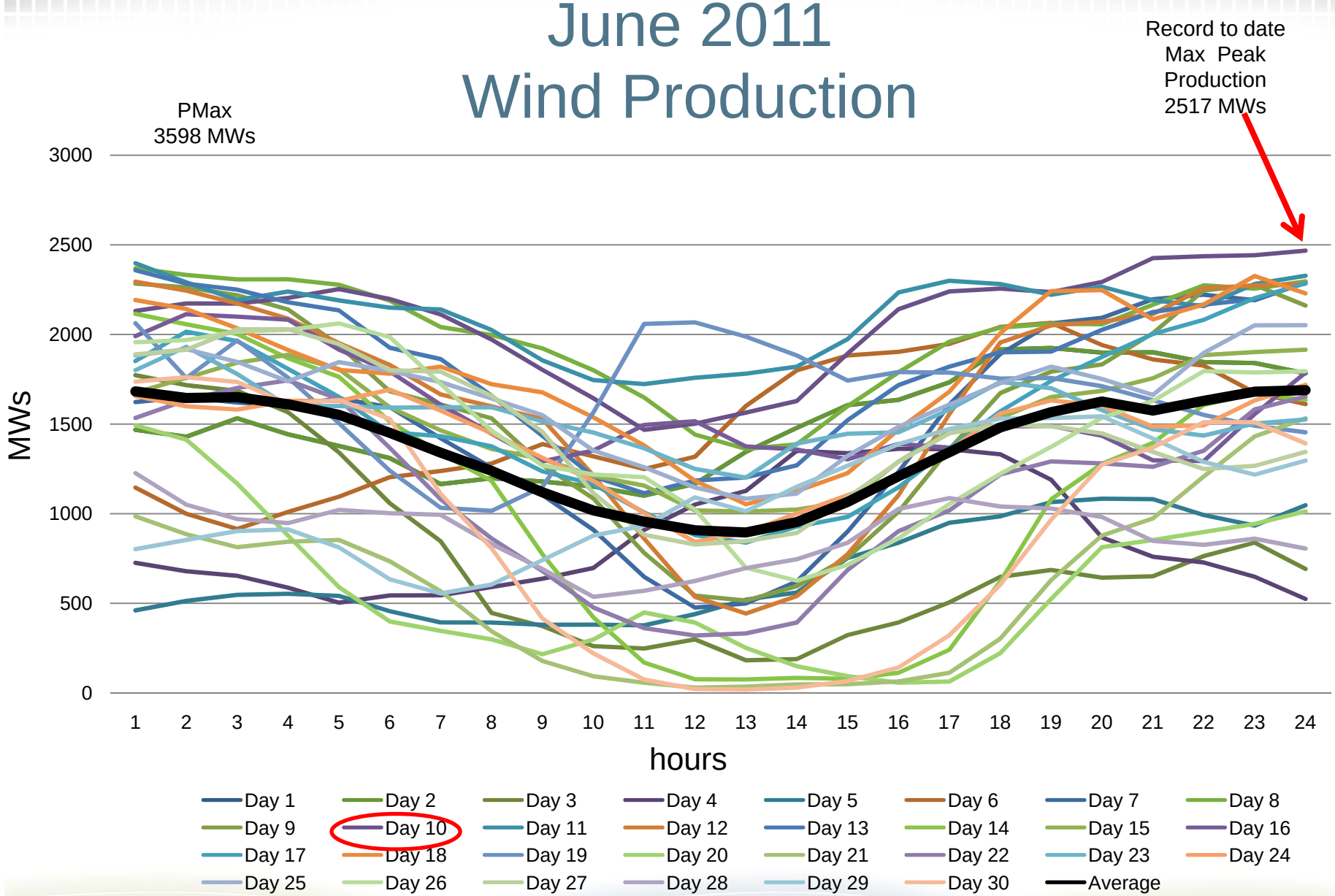
RAMPING!



Source: *2010 Integration of Renewable Resources Operational Requirements and Generation Fleet Capability at 20% RPS*

Wind generation tends to be inversely correlated to daily load curve, creating ramping impacts

June 2011
Wind Production



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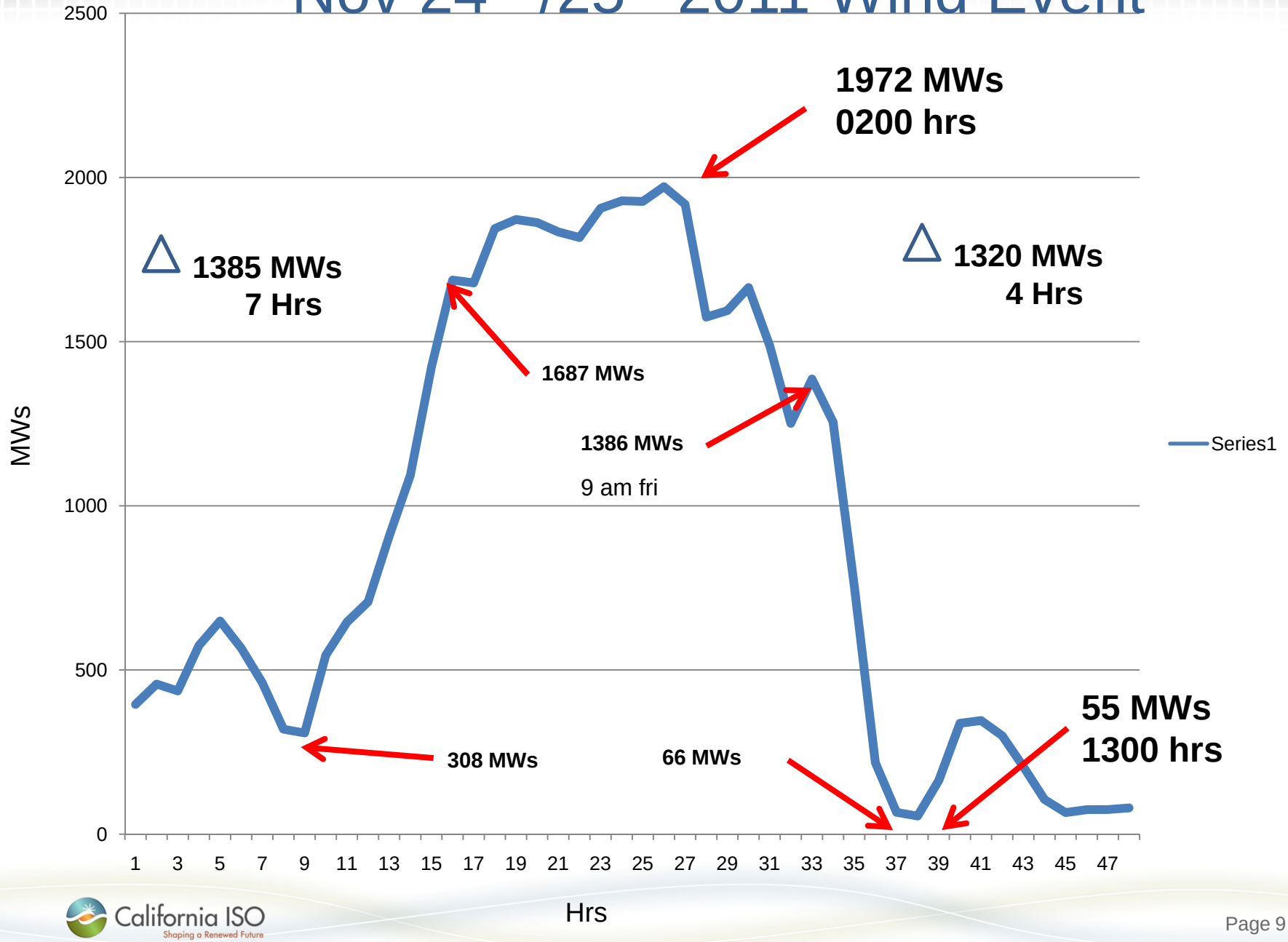
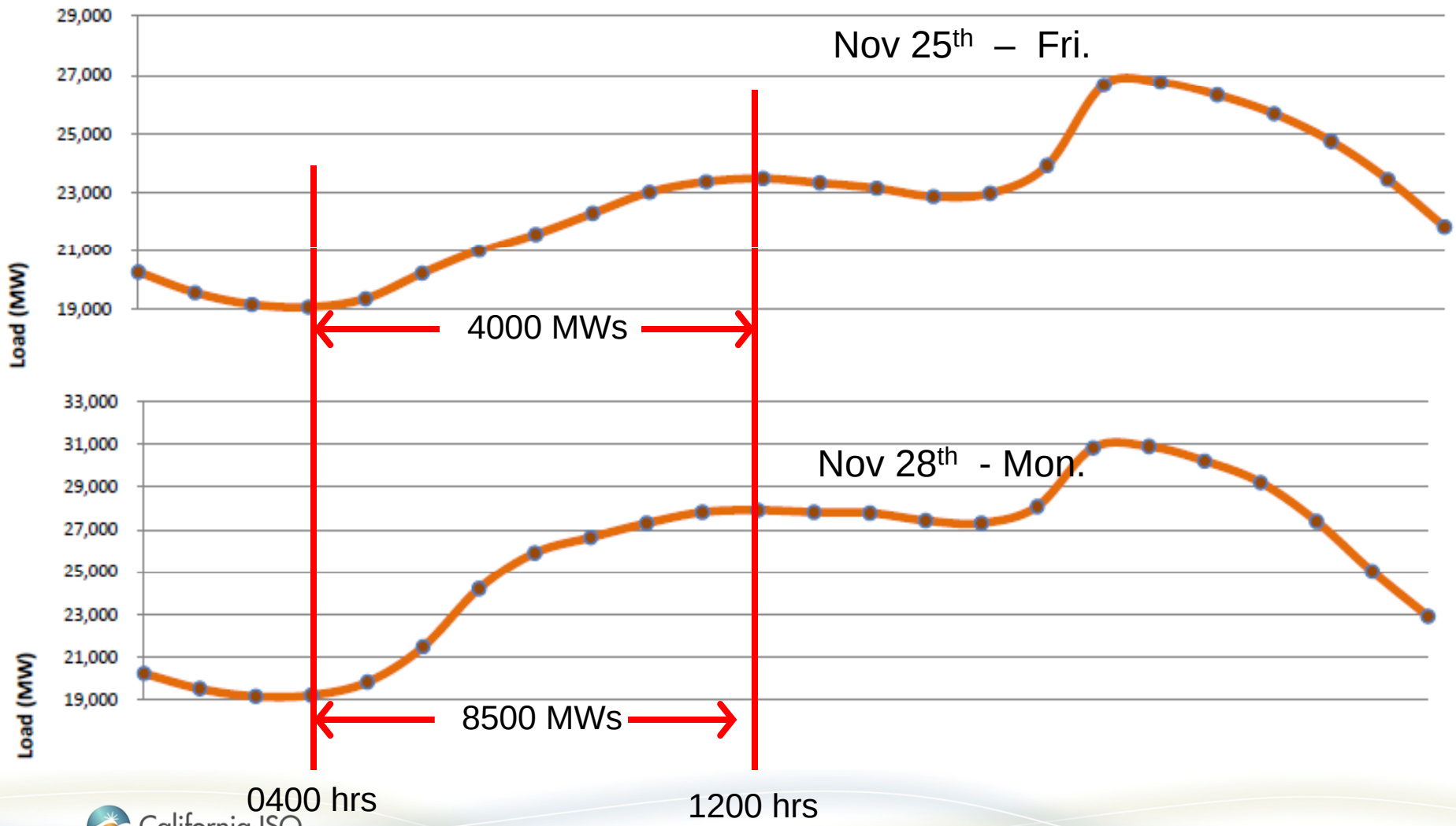
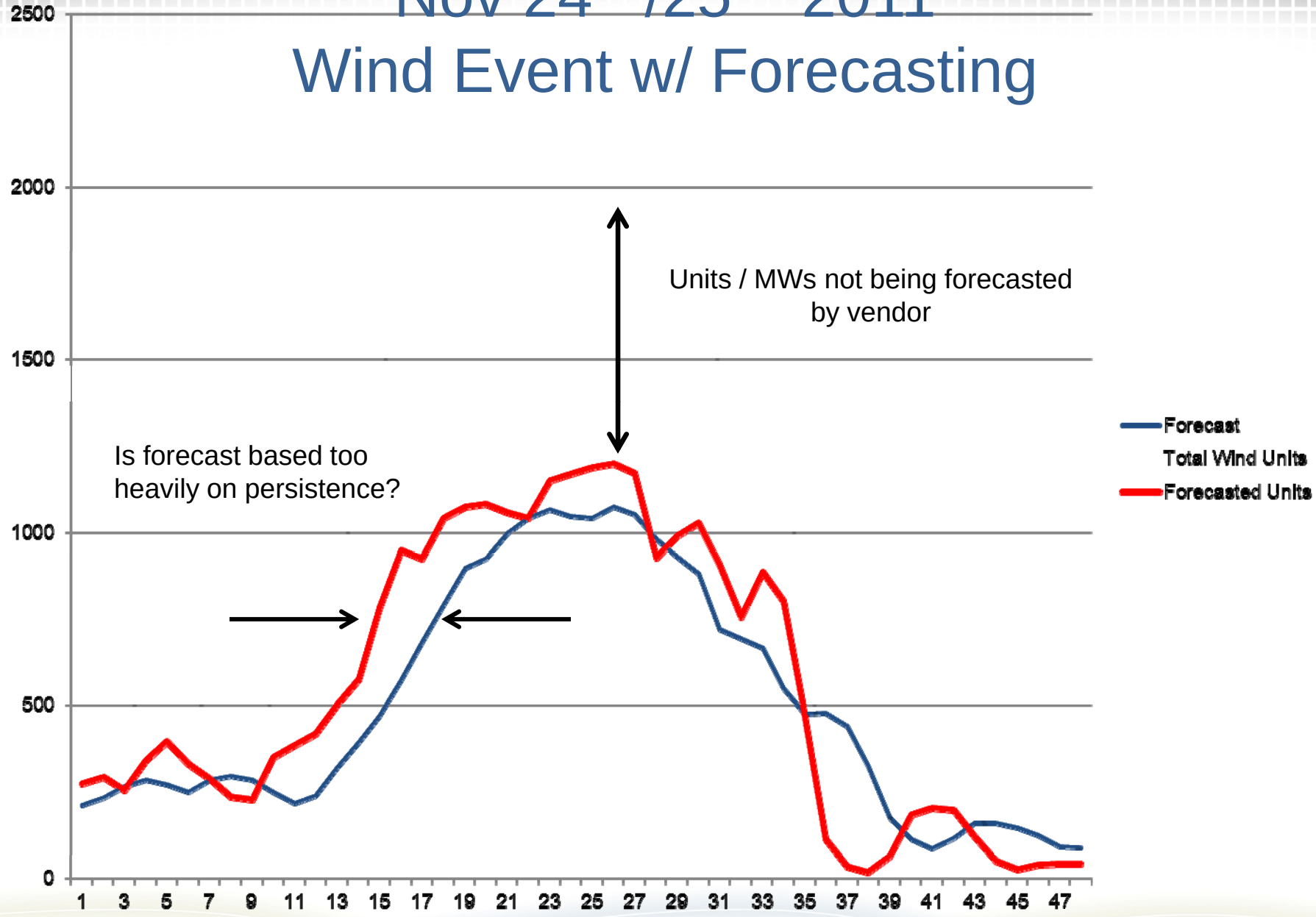
Nov 24th /25th 2011 Wind Event



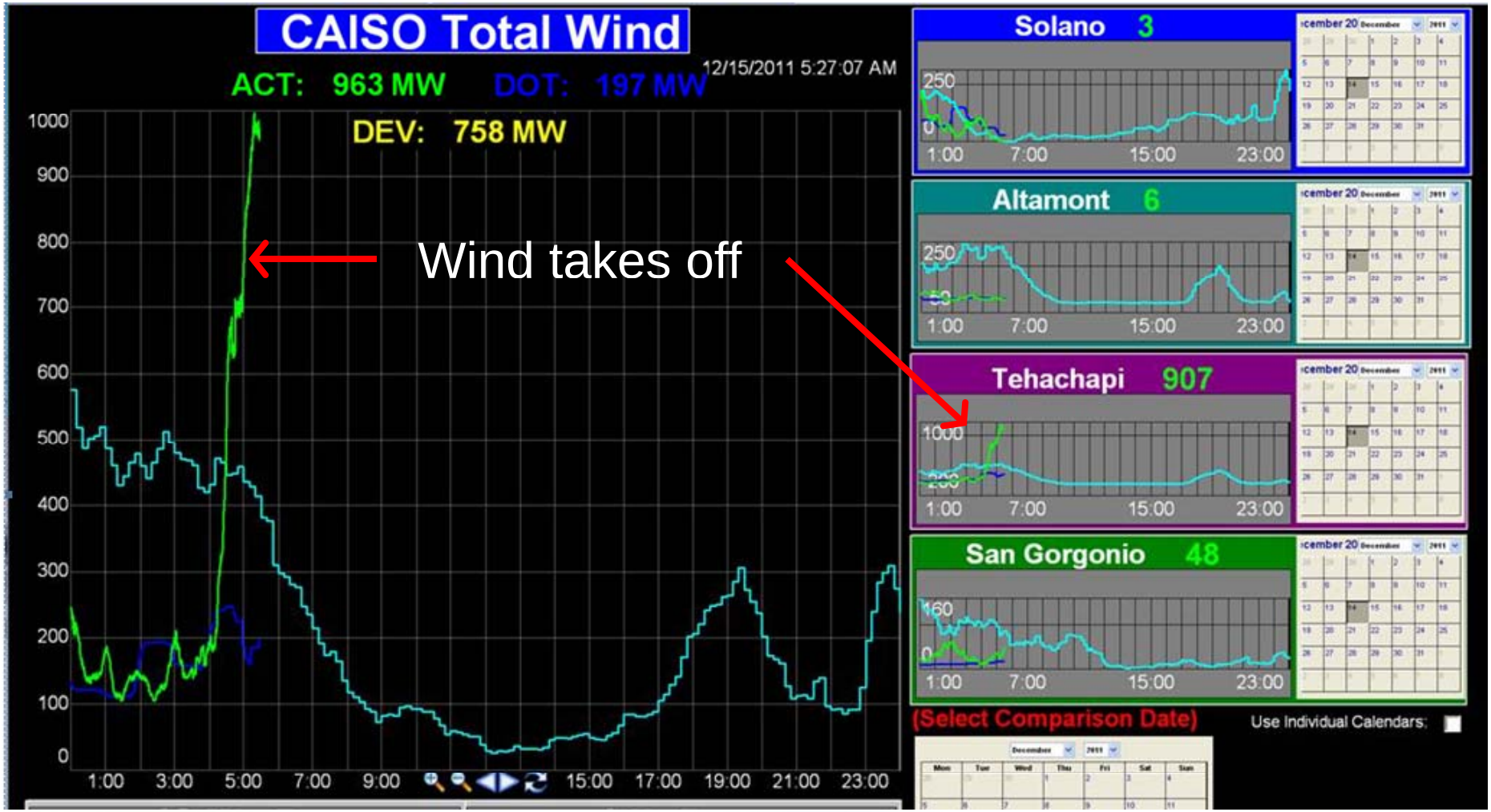
Load Pull Comparison



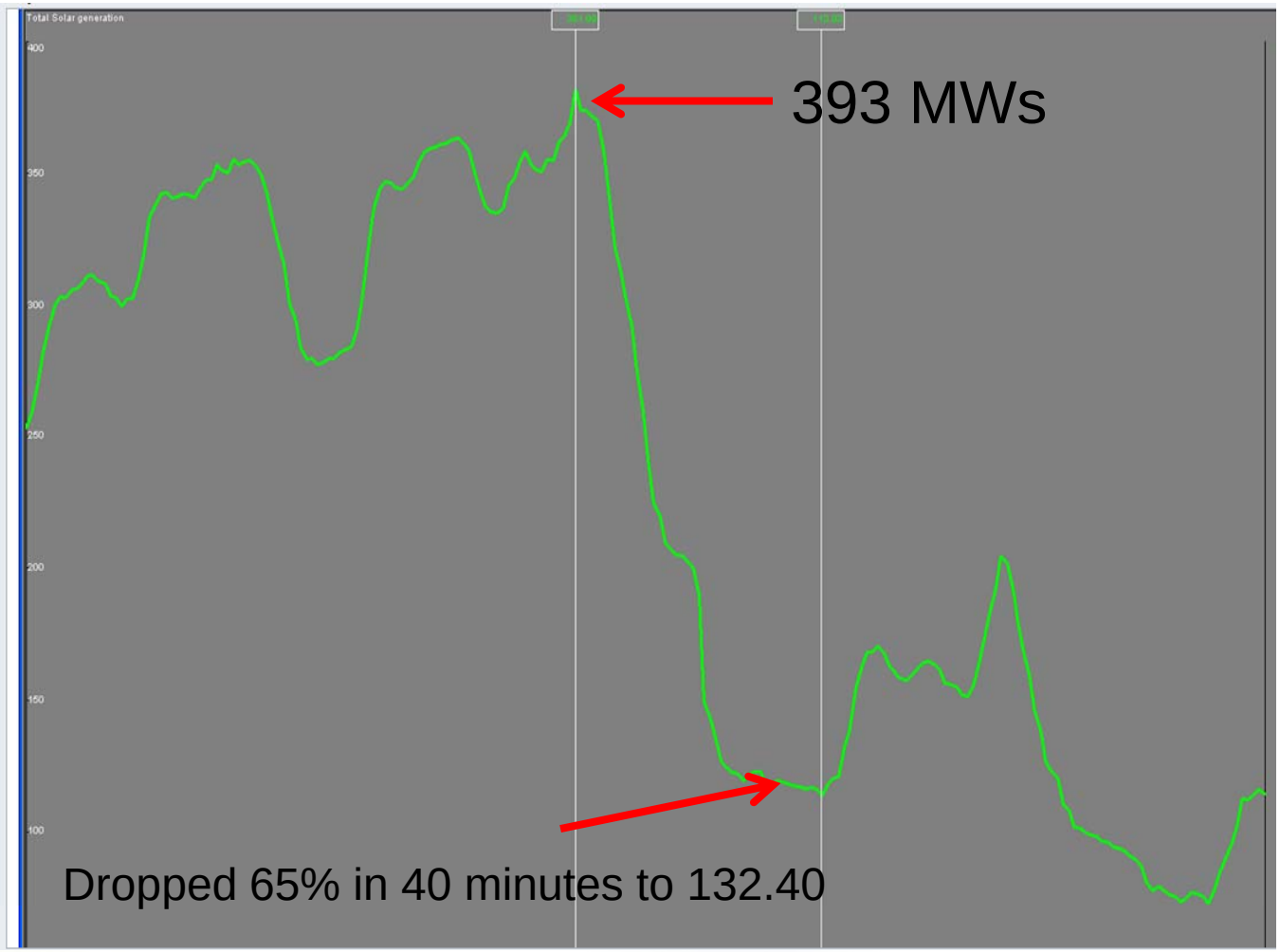
Nov 24th /25th 2011
Wind Event w/ Forecasting



Dec 15th 2011
Wind Event w/ Forecasting



July 3rd 2011 Solar Event
65% Production Drop



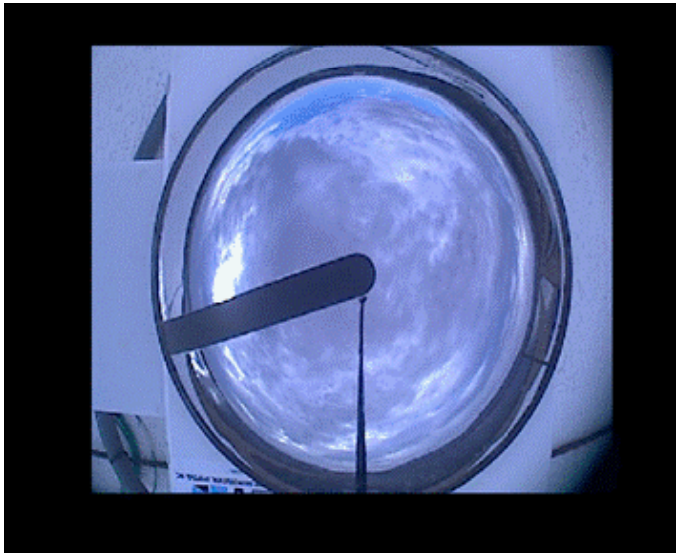
How accurate do we need forecasts?

Reduction in Forecast Error	Wind Energy Penetration	WECC Annual Operating Cost Savings ($M)	Estimated US Annual Operating Cost Savings ($M)
10%	14%	$28M	$140M
20%	14%	$52M	$260M
10%	24%	$100M	$500M
20%	24%	$195M	$975M

http://www.nrel.gov/wind/systemsintegration/pdfs/2011/lew_value_wind_forecasting.pdf 1/26/11

What is the ISO doing for forecasting ?

- Internal
  - Developing algorithms
  - Developing our Renewable Desk operators
  - Looking at other forecasting techniques
- External
  - Obtaining “behind-the-meter” data
  - Working with UC San Diego
  - Working with UC Davis
  - Investigating vendor techniques



Thank you!

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